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Several years ago the faculty of the University of Arkansas College of Medicine redesigned their approach to teaching the basic neural sciences by integrating them into a freshman-level neuroscience course. The primary goal of the course was to provide students with basic science information for application in solving clinical problems. This paper contains a description of the course design, and describes several major instructional techniques including a comprehensive course manual, the use of television in both laboratory and lecture, and the use of the clinical examination as a positive motivational tool. Also, a student-based program evaluation process is detailed. (Author)

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A Multidisciplinary Neuroscience Course with Ongoing Program Evaluation

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ABSTRACT

Several years ago the faculty of the University of Arkansas College of Medicine redesigned their approach to teaching the basic neural sciences by integrating them into a freshman-level Neuroscience course. The primary goal of the course was to provide students with basic science information for application in solving clinical problems. This paper contains a description of the course design, and describes several major instructional techniques including a comprehensive course manual, the use of television in both laboratory and lecture, and the use of the clinical examination as a positive motivational tool. Also, a student-based program evaluation process is detailed.

Traditionally, instruction in the neural sciences has been given independently by preclinical and clinical departments during different years of a student's medical education. Only recently have attempts been made by such clinical departments as Neurology and Neurosurgery to begin teaching in the preclinical years.[1] Several years ago the University of Arkansas College of Medicine initiated an integrated Neuroscience course in the freshman year which was taught by a faculty from the basic science departments of Anatomy, Physiology, Pharmacology and Pathology, as well as clinicians from the Departments of Neurology and Neurosurgery. The goal of such a course was to provide students with basic science information; at the same time they were asked to apply it in solving clinical problems and actually conducting a neurological examination. The later clinical years then could be designed to reinforce the students' knowledge and expose them to a greater experience through direct patient contact. Several instructional techniques used in the Neuroscience course, as well as an evaluation process, will be described.

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A freshman class consists of 120 medical and approximately 12 graduate students. They all enter Neuroscience with a limited background in the terminology and concepts of the body of knowledge; consequently, major attention is focused on basic neuroanatomy, neurophysiology, and an introduction to clinical neurology and the neurological examination. However, freshmen are introduced to material which is covered in more detail in portions of courses in pharmacology, pathology, and biochemistry. Although faculty from many departments lecture on topics in areas of their own expertise, a majority of topics are taught by four staff members to ensure continuity and comprehensive content. The Neuroscience course is designed to fulfill the following objectives:

(1) to provide students with information and experiences which will assist them in utilizing the symptoms and signs of the patient for ascertaining the functional status of his nervous system;

(2) to provide students with demonstrations of, and experience in, the procedures employed in differential diagnosis;

(3) to provide sufficient basic information in the neurosciences to enable students to proceed successfully through courses in physiology, pathology, physical diagnosis, pharmacology, surgery and medicine;

(4) to introduce students to the use of basic and clinical neuroscience literature so that they will be able to keep abreast of this source of information during their medical education and professional life.

Instructional Experiences

Using the course manual as a guide, students are introduced to material in lectures, laboratories, clinical demonstrations and review sessions. Information concerning the anatomy, physiology, and clinical neurology of each particular neural system is integrated into a well-defined block of time. Instruction in each block is presented according to the following sequence: structure, function and clinical application. The

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course manual is organized chronologically and contains an outline for each lecture and a reading assignment, thereby allowing students access to future material so they may study Neuroscience at their own pace.

Since clinical material is presented last within each block, the clinical faculty are able to attend pertinent lectures and present clinical correlations and patients which closely follow the basic science material. For example, the general anatomy of the spinal cord is presented, followed by the function of muscle receptors and the physiology of reflexes. Subsequent lectures cover other sensory receptors and ascending pathways, and then descending pathways in the spinal cord. These lectures are followed immediately by a demonstration of the clinical examination of motor and sensory functions, utilizing patient presentations, and discussion of the functional anatomy and disorders of the spinal cord.

Similar blocks of time are used for brain stem and cranial nerves, cerebrum, cerebellum, the basal ganglia with thalamus and hypothalamus, and higher functions of the brain. Neuropathology correlates are presented where appropriate, such as Parkinsonism, a disease chosen to represent degenerative diseases of the basal ganglia. Early in the course, emphasis is placed on neurocytology, basic neuropathology, neuroembryology, neuroelectrophysiology and a discussion of the lower motor neuro unit from the clinical standpoint.

The course is organized to make possible utilization of the laboratory for presenting material related to the lecture topic and, more specifically, to allow more lecture time for concepts of structure and function. Little lecture time is devoted to pure descriptive neuroanatomy. Laboratory protocols in the course manual include the following sections:

1. *Purpose* – a statement of the objectives of the lab session;
2. *New Vocabulary* – a list of anatomical structures to be studied during the lab session;
3. *Materials* – items necessary for students to have for instruction; these include gross brain specimens, Weigert slides of brainstem, models, or demonstrations. The brainstem slide set is reproduced in the course manual atlas and can be used in lieu of slides;
4. *Today's Project* – a comprehensive description of how students should proceed and what should be observed as they follow the steps through the project assigned for the day;
5. *Clinical and Pathological Problems* – a problem set for student use to reinforce recognition of anatomical and functional patterns.

A particularly effective instructional resource for laboratory use is television. To utilize faculty and student time most efficiently, a demonstration of the material in the protocol is televised to all students at the beginning of the lab and is presented at a pace with which the class is comfortable. A closed-circuit color television system is utilized to implement this demonstration; students follow it on a monitor near them while simultaneously identifying the structures on their own material. The demonstrator is in the classroom rather than isolated from the class in a studio. Circulating lab instructors answer individual student's questions, or when it seems necessary to clarify a point for the whole class, these instructors contact the demonstrator through a wireless microphone and ask him to repeat or further explain the point. These "show and do" demonstrations last one hour, after which faculty circulate to answer questions as students continue to study the material. Five to seven faculty members are available for each laboratory, and the responsibility for the formal presentations is rotated.

Faculty believe the utilization of television allows more time for instructors to work closely with students in the lab answering conceptual rather than procedural-type questions. Also, it is the consensus of faculty opinion that the use of television makes teaching in the laboratory more efficient for helping students to comprehend the information. Television has not had a dehumanizing effect on the teacher-student relationships; instead, use of it has increased the opportunity for contact of faculty with individual students.

Television is used also in lecture sessions. When patients are admitted to the University Hospital with clinical problems which could be useful illustrations in the Neuroscience course, it is possible to videotape them on the ward using a portable unit. The tape is then viewed by the students at the appropriate lecture during the

course. More often, patients are brought into the lecture room, and a neurological examination is performed there. The portable television system is used to emphasize special points of interest that may not be visible to all persons in the lecture room. These sessions are all recorded on videotape for review by students and to provide for the growth of a collection of instructional materials.

Assessment of Student Performance

Optional review sessions, followed by comprehensive examinations, are the means of identifying problem areas and insuring faculty that students are keeping abreast of the instructional material. During the eleven-week course, students are examined using three different types of tests. All didactic examinations are in the National Board Examination format and are machine scored. Computerized item analysis is used to statistically validate examination questions over several semesters.

The laboratory examinations are short-answer practicals. These tests consist of tagged structures, x-rays or the Weigert brain stem sections. Students either identify the structure or answer a question about its function.

Finally, the clinical faculty tests each student on his ability to perform a clinical neurological examination and localize pathologic processes. Both in-patients and out-patients of the Neurological and Neurosurgical Departments are utilized for this examination. Successful completion of this exam is a major goal of the course and provides faculty with information on the effectiveness of instruction in helping students to solve clinical problems with basic neuroscience information. Conducting this examination requires time and effort from the clinical faculty members. However, these faculty members feel this experience should be provided because of the positive impact on the motivation of students.

By the end of the course, the transition from basic science to clinical application has been completed, and students are eager for further clinical exposure to broaden their experience. Graduate students, who are not continuing into clinical medicine, also benefit by gaining insight into the problems of clinical medicine before they are involved as instructors in similar courses. The need for continued reference to new or unexplored basic science material is apparent to both medical and graduate students.

Program Evaluation

A significant component of the Neuroscience course is the student-based program evaluation. The Neuroscience faculty requested the Division of Biomedical Communications to assign an Instructional Development Specialist (evaluator) to design and conduct an evaluation of the course. This request was based on three faculty desires: (1) to conduct the course in a manner to assure each student the highest possible opportunity for success; (2) to gain information about the effectiveness of each planned instructional experience; (3) to have an objective third party obtain information that may not have been acquired in course evaluations previously conducted by the faculty.

Formative evaluation was selected as the process for evaluating the course. Formative evaluation may be conceptualized as the process wherein developers of prototype instructional systems collect and analyze information for purposes of correcting system deficiencies.[2] It also is particularly useful to identify and gauge "side" effects and unanticipated phenomena in the instructional environment.

The formative evaluation plan devised for the Neuroscience course utilized students as the primary source of information. They were responsible for providing attitudinal data on the effectiveness of each instructional experience and their performances on tests were subjected to analyses. Information obtained from these activities was then communicated to faculty for making decisions to modify teaching methods and/or the structure of the course as it progressed. The general areas considered in the assessment included: (1) effectiveness of instructors' teaching styles, (2) instructional experiences and materials, (3) design of the course, (4) student performance on examinations, and (5) the program evaluation process itself.

Three techniques were employed to gain information: (1) attitudinal questionnaires; (2) student conferences; and (3) test-item analysis. Since students were the primary source of information, each was given an opportunity to evaluate a portion of the course: thus all students were involved rather than a random sampling of the class. The class was divided into seven groups of 19 students. Each group was asked to complete

an attitudinal questionnaire for specific lecture and laboratory sessions and to attend a weekly conference with the Instructional Development Specialist. Since a number of faculty were responsible for teaching various Neuroscience topics, daily evaluation was necessary to collect the most reliable data. Items on the questionnaire were compiled from reviews of previous Neuroscience questionnaires, literature on program evaluation[2,3,4] and in consultation with faculty. Student conferences, the second technique, were conducted in order to explore further the data gathered from the daily questionnaires. Finally, the effectiveness of each instructional experience in helping students gain cognitive information was scrutinized through a test-item analysis of student performance on objective tests. The results of the questionnaires, conferences and test-item analyses were reported in writing to the faculty by the evaluator. He was available for discussion, and to offer suggestions and assistance to faculty for alternative instructional techniques.

After the course, the entire class completed a final questionnaire and attended a conference. Questionnaire items and the final conference discussion centered around primary concerns of the students identified from the daily questionnaires and from the weekly student conferences. Based on results obtained from the final conference, the Instructional Development Specialist then recommended alternative instructional techniques to the faculty.

During the course, unanticipated results of the program evaluation were perceived and were confirmed in the final data. One unanticipated phenomenon or "side" effect, was a unique role for the evaluator. By being knowledgeable of most aspects of the course, and by being in continuous communication with both faculty and students, he was able to provide each group with explanations of the other's behavior. Confusing and problematical situations were clarified for both students and faculty. This ombudsman-type role helped to relieve some of the normal frustrations of most students and contributed to creating a positive feeling for the course.

Upon completion of the course, the Instructional Development Specialist requested the faculty to assess the evaluation program. Though the Neuroscience faculty judged it to have produced information that otherwise would have been unattainable, it was recommended that certain aspects of the process be revised for greater effectiveness in future projects. The faculty recommended that the Instructional Development Specialist:

(1) formulate regularly scheduled faculty conferences to clarify and discuss results and to explore alternative teaching strategies when necessary;

(2) work with faculty to develop mutually agreed upon criteria to gauge teaching effectiveness;

(3) attend all lecture and laboratory sessions to assess teaching performances;

(4) devise a program and/or strategies for assisting faculty to develop more effective teaching methods;

(5) include criteria for faculty peer review.

The third party evaluator, through the students, was able to provide faculty with information on the effectiveness of instructor teaching styles, planned instructional experiences and materials, and course structure. The positive aspects of the course were delineated and exploited. The negative aspects were either dealt with immediately by the faculty or procedures for solving them were planned. As a result of their active participation, students became aware of some of the constraints faculty face in conducting a course. They also contributed to improving the course for themselves as well as for students who will follow them. Most importantly, the program evaluation provided faculty with information enabling them to increase the effectiveness of the course as it progressed, thus assuring each student the highest possible opportunity for success.

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